Peplink Antenna Guide

Theory, Application and Choosing the Right One

Peplink Mission

peplink

Unbreakable Connectivity

ANYTIME

ANYWHERE

Today Agenda

Theory

1. Antenna types
2. Key parameters
3. Frequency and attenuation
4. Consideration criteria
5. Cables and Connectors

Applications

1. Typical applications
2. Peplink antennas
3. Antenna combinations

Q&A

Theory

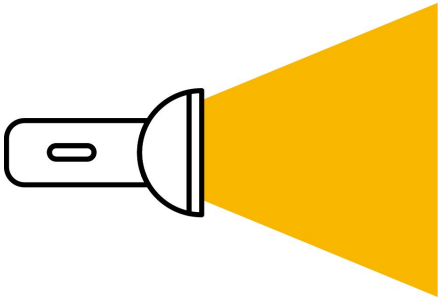
Antennas

Types of Antennas

Omnidirectional Antennas

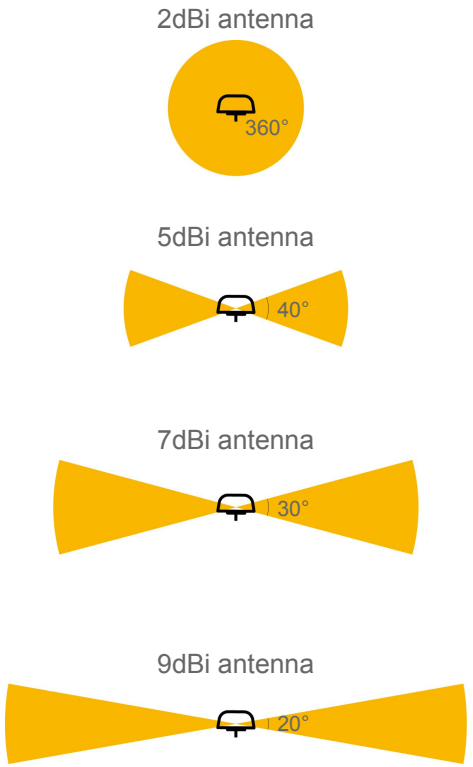
Pros	Cons
• Rotatable platform • Stable signal	• Lots of noise

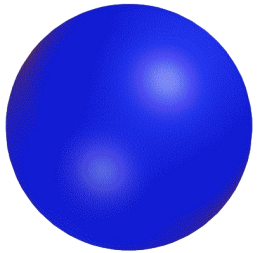
Directional Antennas

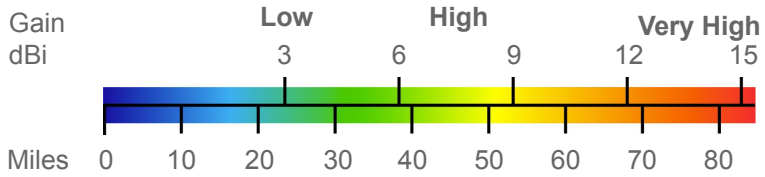


Pros	Cons
• Longer range • Higher gain	• Easily Misaligned

Omnidirectional Antennas

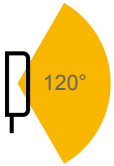




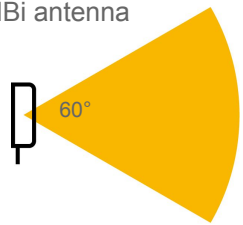


Directional Antennas

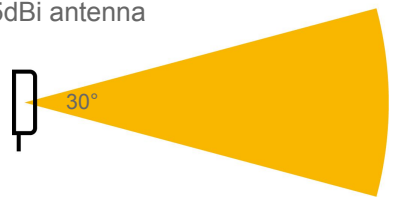
3dBi antenna

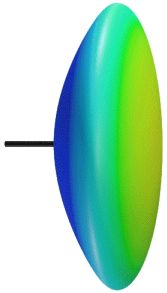


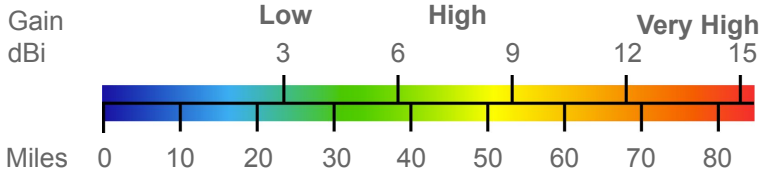
9dBi antenna



15dBi antenna







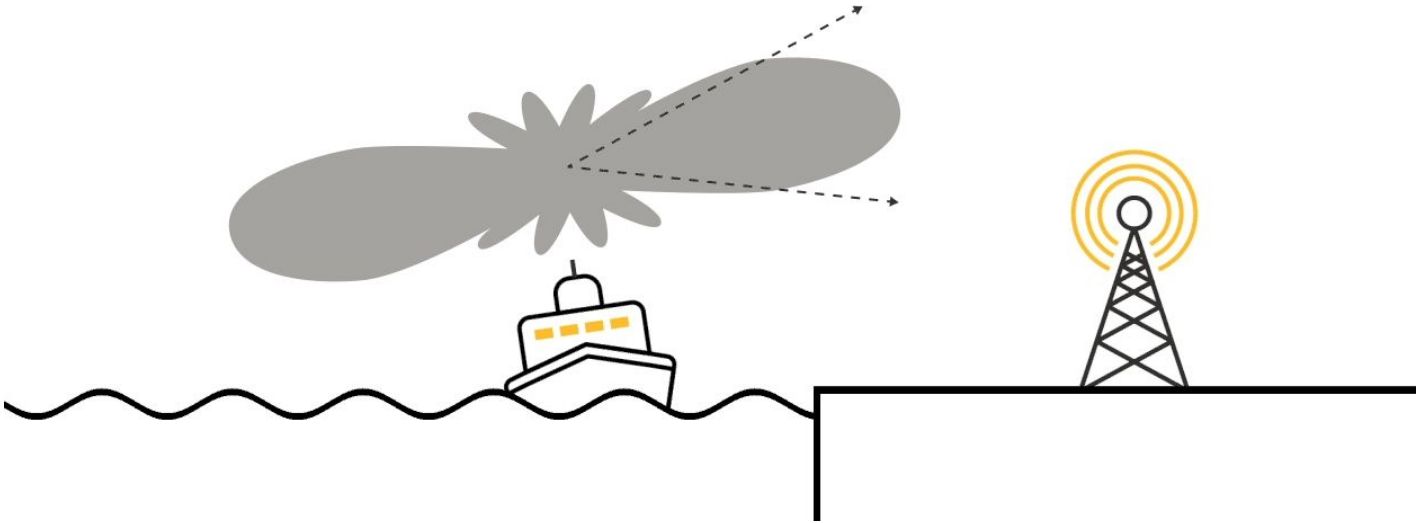
Gain

Types of Gain

Lower Gain Antenna

vs

Higher Gain Antenna

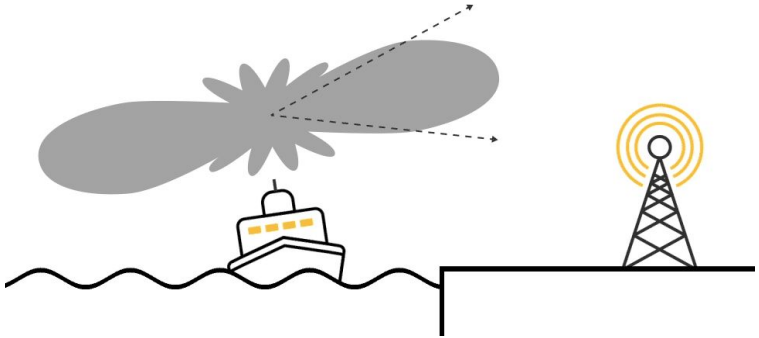


Gain

Types of Gain

Lower Gain Antenna

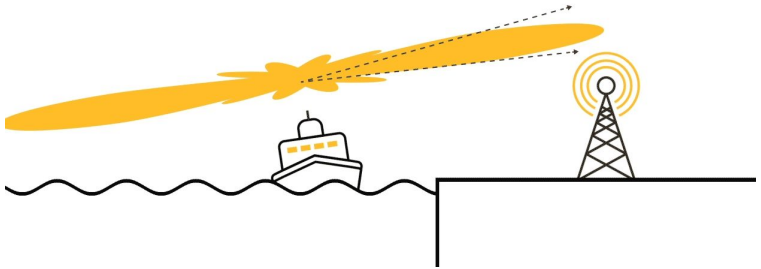
- Antenna gain of 4 to 7dBi => 20° to 40° elevation beam-width => allow for 10° to 20° roll either way



Pros	Cons
• Easier to install • Less likely to be misaligned and lose signal • Compact antenna housing	• Shorter range

Higher Gain Antenna

- A ship rolls to 10° on moderate seas, either way, sometime more (vessel and sea conditions)
- Antenna Gain of 9dBi => 12° Antenna elevation beam-width => allows for +6° roll and +6° roll either way



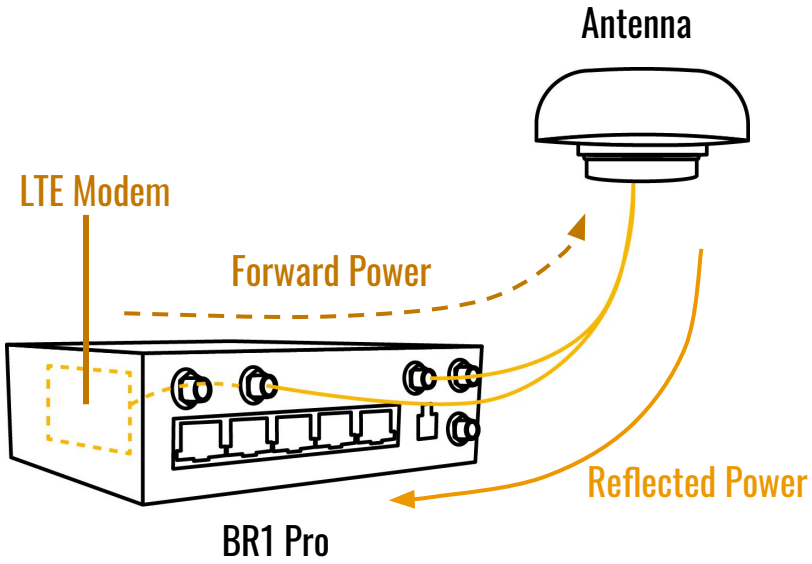
Pros	Cons
• Longer range	• May be misaligned and degrade signal • Larger antenna housing

- Too high gain = overshooting the target base stations on shore
- Too low gain = inefficiency

Voltage Standing Wave Ratio(VSWR)

Reflection coefficient

- Indicates **how much power** is reflected from the antenna when the cellular router is transmitting
- Too high VSWR could permanently damage cellular router modem
- Common range **1.5 - 2.5**

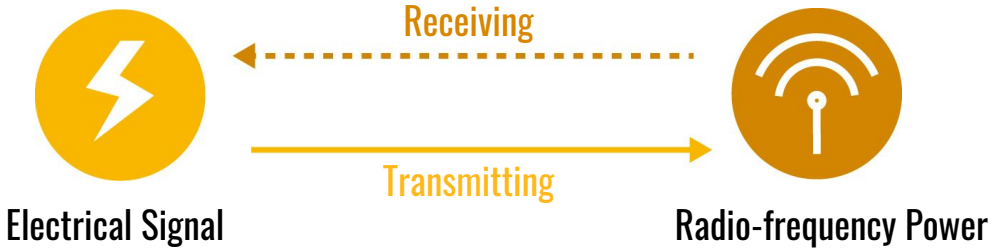


Efficiency

How good antenna converts the radio-frequency power to electrical signals and vice versa

- High gain + Good VSWR + **Low efficiency**
  → poor signals
  → low cellular router performance

- Typically efficiency varies from **30% - 90%**
  (depending on the frequency and antenna type)



Frequency and Attenuation

Available frequency bands

Simplified spectrum split into different bands for today LTE/5G networks.

Bands	Low band	Mid band	High band	High band (ISM)
Frequency [MHz]	600-960	1700-2700	3400-4200 (5G)	5100-6000 (5G)

Frequency and Attenuation

Factors mainly caused Signal Attenuation

Frequency

higher frequency == higher attenuation

Distance

longer distance == higher attenuation

Physical Surroundings

e.g. hills, buildings, trees, walls

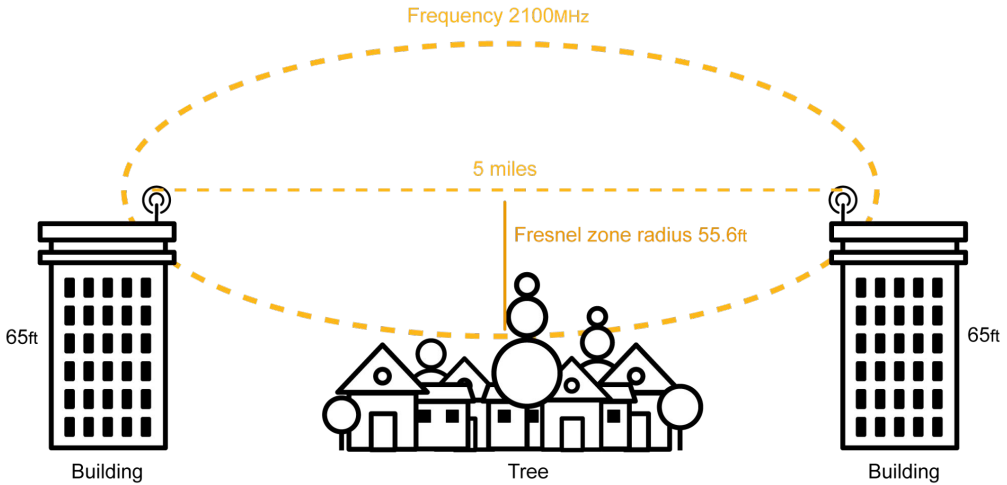
	Rural Low population	Suburban Medium population	Urban Dense population
Description	Low population. Typically farming or open fields.	Mildly populated areas. Typically small population with residential areas or small offices.	Densely populated areas. Typically with high rise buildings for residential or commercial use.
Frequency Bands	Mainly **Low**	Mix of **Low** and **Mid**	Mix **Mid** and **High**
Signal attenuation	Low	Medium	High
Cell tower coverage	Large	Medium	Small
Cell tower density	Low	Medium	High
Throughput	Low	Medium	High
Cell tower density	Low	Medium	High

Consideration Criteria

Goal: get the best possible received signal

1. **Line-of-sight and Fresnel Zone**
   - no objects in between (e.g. trees, buildings, hills, walls)

2. **Cell tower congestion**
   - especially seen during rush hours or during weekend in certain areas(e.g. all users get back home)

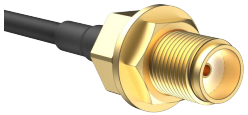


Cables and Connectors

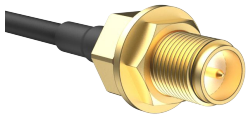
Routers

Subminiature type A (SMA)

ROUTER side

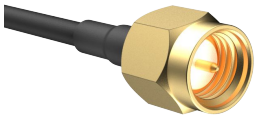


SMA Female
Cellular/GPS

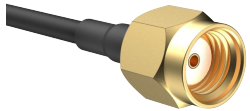


RP-SMA Female
Wi-Fi

ANTENNA side



SMA Male
Cellular/GPS



RP-SMA Male
Wi-Fi

QMA

ANTENNA side

Male

ROUTER side

Female

Upgraded installation of MBX CAT-12, we have an adapter to convert from QMA to SMA - "**QMA-to-SMA adapters (Pack of 4) ACW-816**".

When upgrading from CAT12 to higher, 4 antennas are required for each LTE/5G modem instead of 2.

Cables and Connectors

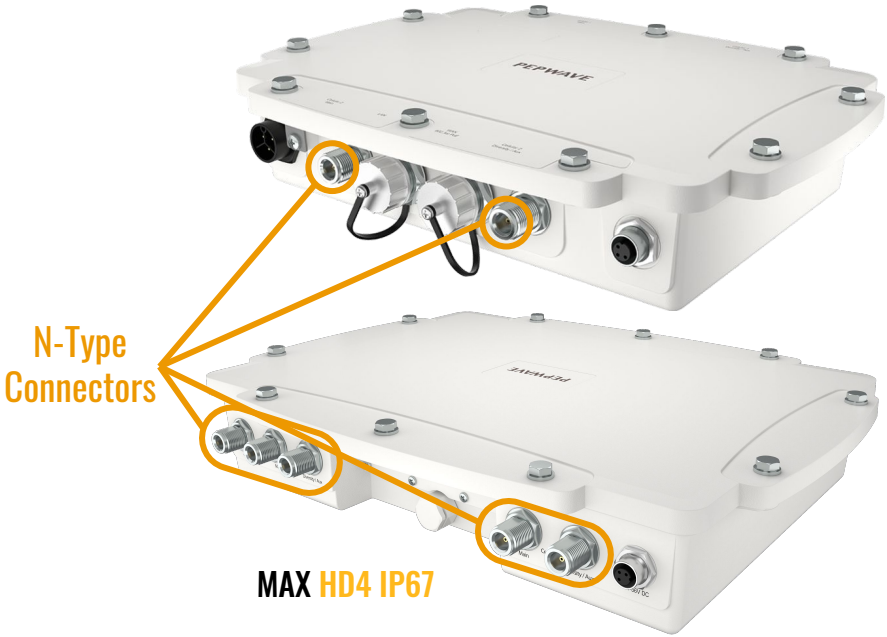
Antennas and cables

N-Type

Male
(Antenna)

Female
(Router)

MAX HD2 IP67



MAX HD4 IP67

Cables and Connectors

Antennas and cables

Cable type	Loss	Notes	Connector	Loss @ 900MHz 6 ft (2.1m)	Loss @ 2000MHz 6 ft (2.1m)	Loss @ 2500MHz 6 ft (2.1m)	Loss @ 5000MHz 6 ft (2.1m)
RG-174	Moderate	Flexible, 0.1" (2.5mm) in diameter, up to 2.7GHz	SMA or QMA	2.24 dB	3.43 dB	3.85 dB	-
CFD-200	Low	Flexible, 0.2" (5mm) in diameter, up to 6GHz	SMA or QMA	0.66 dB	0.99 dB	1.11 dB	1.73 dB
LMR-400	Very low	0.45" (10mm) in diameter, >6GHz	N-type	0.28 dB	0.42 dB	0.49 dB	0.84 dB
LMR-600	Ultra low	0.59" (15mm) in diameter, >6GHz	N-type	<0.07 dB	<0.07 dB	<0.07 dB	0.7 dB

! RG-174 cable is used for GPS:

- Loss @ 1500MHz is ~2.63 dB

Applications

Typical Applications

Types of installation

Fixed

e.g. offices, factories or homes

⇓

Hummingbird

Mobile

e.g. First Responder vehicles, trucks, buses, trains or RV

⇓

Puma

Maritime

e.g. vessels

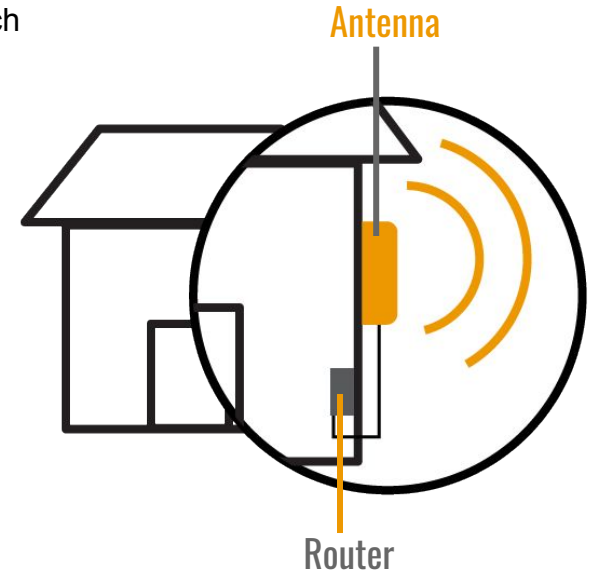
⇓

Stingray

Fixed Installations

e.g. offices, factories or homes

- Perfect for Rural and Suburban areas which need **external antennas**
- Compared to indoor antennas helps to:
  - Improve signal
  - Reduce noise
  - Increase overall performance



Hummingbird 201/ 401

Directional antenna

Supports GPS

Decreases noise reception
Improving overall connectivity performance

Supports robust and reliable Wall
With **Pole mounting**

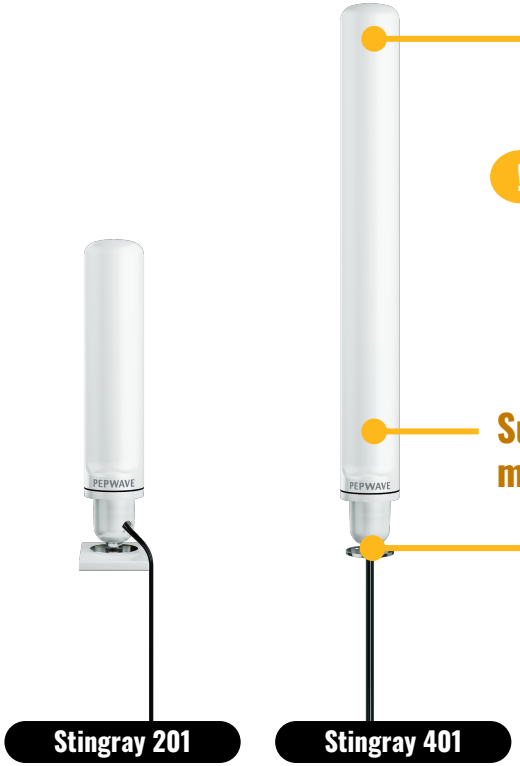
- **5m cable with SMA connectors**
  Directly connected to the cellular router

SMA connectors are **not waterproof** and would require additional sealing.

- **0.5m cable with N-type cables**
  If the extension cable runs longer than 5m, **a low loss LMR cable** is allowed to use

Stingray 201 / 401

Omnidirectional antenna

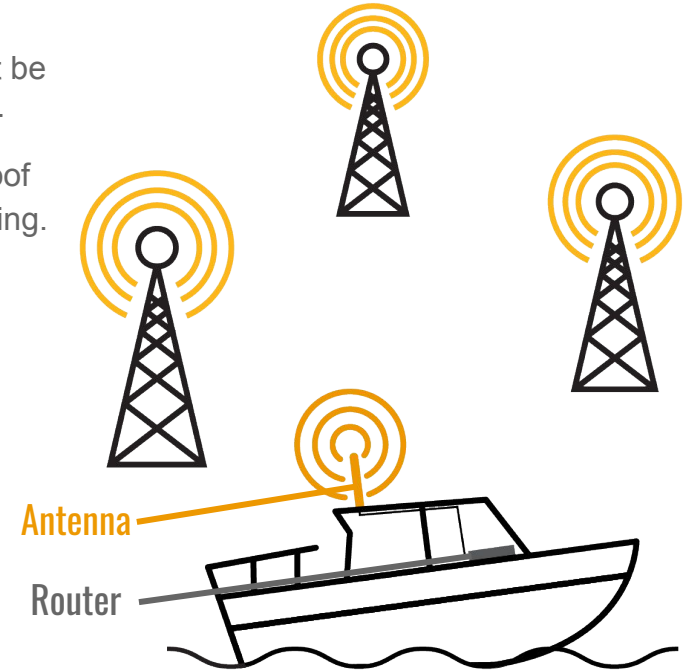


2m cable with SMA connectors
Additional extension cables might be needed depending on installation.

! SMA connectors are not waterproof and would require additional sealing. It is recommended to use **self amalgamating tape** to seal connectors.

Supports Deck, Wall or Pole mount options

Designed to withstand 160 km/h wind load



! Good for connectivity when direction is ever changing

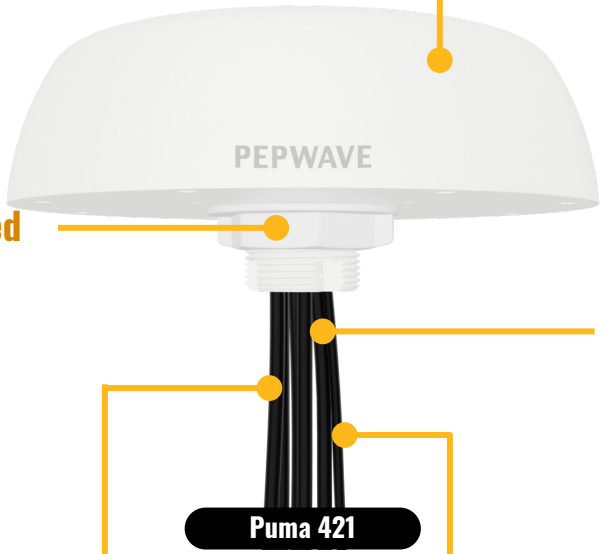
Mobile Installations

e.g. First Responder vehicles, trucks, buses, trains or RV

Puma 020 / 201 / 221 / 401 / 421

Omnidirectional antenna

Able to install on vehicle roof top
Small size + Low profile
→ **minimize drag effect**



IP68 rated

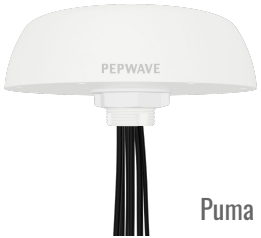
Withstand harsh weather conditions

Support panel, pole and wall mounting

Robust Design
Resistant to **mechanical damage** → making them vandal proof

Comparison Table

Peplink cellular antenna



Puma

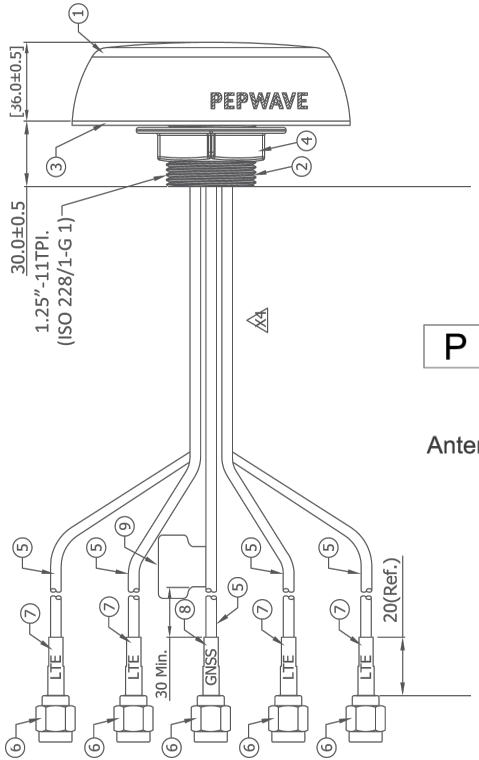
Stingray

Hummingbird

	Puma Series	Stingray Series	Hummingbird
Models	421, 401, 221, 201	401, 201	201, 401
Type	**Omnidirectional**	**Omnidirectional**	**Directional**
Applications	**Mobile, Maritime, Fixed**	**Maritime, Fixed**	**Fixed**
Bandwidth	Very wide (600-6000MHz)	Ultra wide (400-6000MHz)	Very wide (600-6000MHz)
Performance	Medium	High	Very high
Ruggedness	High	Medium	Medium
Active GPS	Yes	Yes	Yes

Numbering System

Peplink antenna



4x 4G/5G antenna elements number

0x Wi-Fi antenna elements number

1x GPS antennas number

P U M A - 4 0 1 - Q - W - 1

Antenna series name

RF cable length in ft
(2 options: 1 - 1 ft / 0.3 meter, 6 - 6.5 ft / 2 meter)

Color
(2 options: W - white, B - black)

RF connector type
(3 options: S - SMA male, Q - QMA male, N - N-type male)

Cable and Connector

Puma Series

Connectors:

1. **1ft (30cm) cable** and QMA connectors (extension cable available)
2. **6.5 ft (2m) cable** and QMA connectors (extension cable available)
3. **6.5 ft (2m) cable** and **SMA** connectors

Extension Cables:

1. 4.5m **SMA male** to QMA (for LTE/5G)
2. 4.5m **RP-SMA male** to QMA (for **Wi-FI**)
3. 4.5m **QMA** to QMA (for LTE/5G)

Stingray Series

Connector:

6.5 ft (2m) cable and **SMA** connectors

Hummingbird Series

Connectors:

1. **16 ft (5m) cable** and **SMA** connectors
2. **2 ft (0.5m) cable** and **N-type** connectors

Puma Antenna

SKU combination

	Puma 401	Puma 221	Puma 020	Puma 421
SMA Connector	2m only	2m only	2m only	2m only
QMA Connector	**0.3m or 2m**	0.3m only	0.3m only	**0.3m or 2m**
Extension Cable	+4.5m	+4.5m	+4.5m	+4.5m

Q QMA connectors are designed as **snap-on locking replacements** for the standard SMA connectors. In the case of an extension, using a QMA connector is **quick to install** and **prevents any interventions in the future** in comparison to SMA or N-Type.

More About SMA and QMA

SMA

Pros	Cons
• Affordable price • Easy to buy	• Takes time to attach • Needs to double check connection

QMA

Pros	Cons
• Can be plugged in very quickly • Secure and reliable connection	• Expensive • Not common

Why CAT 18 / 5G have 4 connectors

MBX HD4 CAT-12

MBX HD4 CAT-18

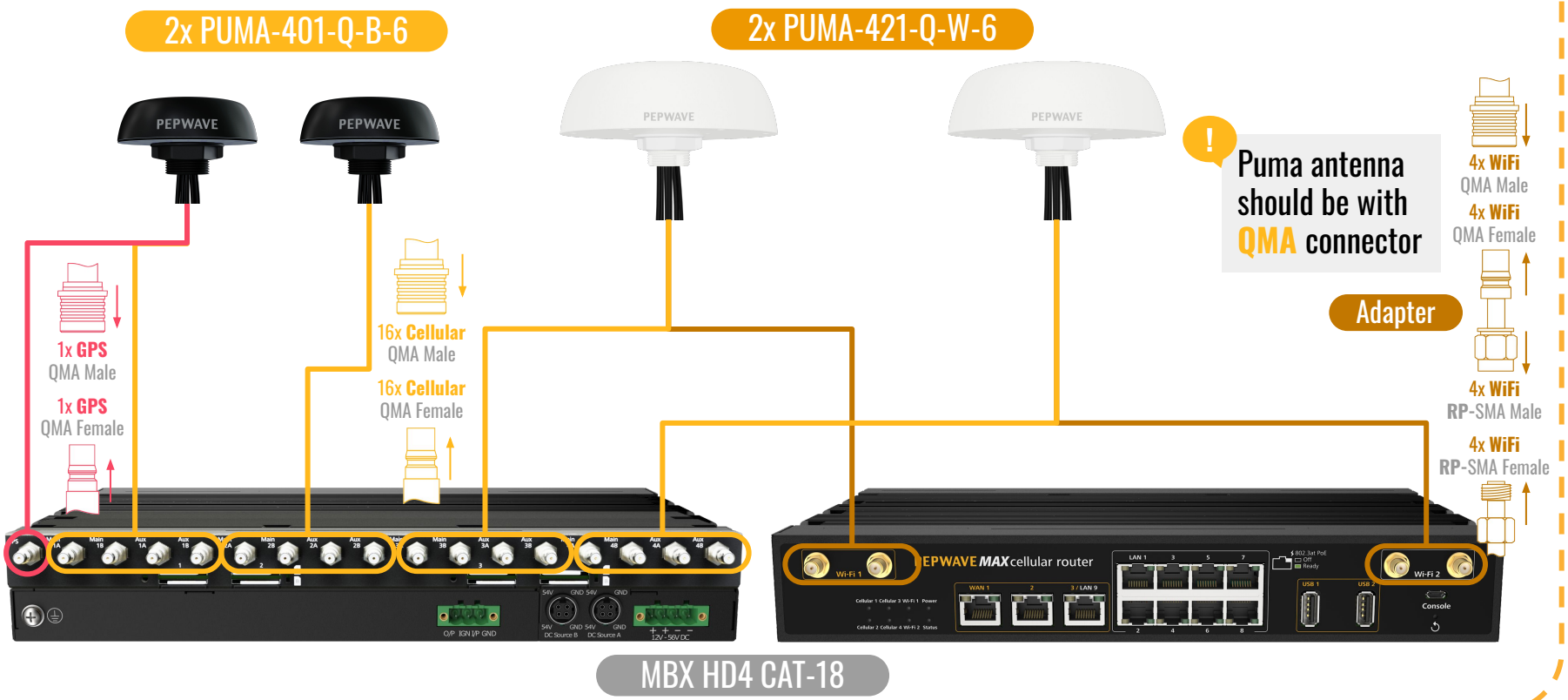
Puma antennas for Peplink routers

Peplink router	Puma model
MAX BR1 (Classic, Mini, Mini Core, MK2, Pro) MAX Transit Mini, MAX Transit	221
MAX Transit (CAT-18, Duo)	421
MAX HD2	421 + 020
MAX HD2 Mini	401
Balance 30	221 + 020

Peplink router	Puma model
MAX HD4	2x 401 + 2x 020 OR 2x 421
MAX HD4 MBX CAT-12	2x 401 + 2x 020 OR 2x 421
MAX HD4 MBX CAT-18 / 5G	2x 401 + 2x 421 (QMA Puma required)
SpeedFusion Engine	401 (adapter required)

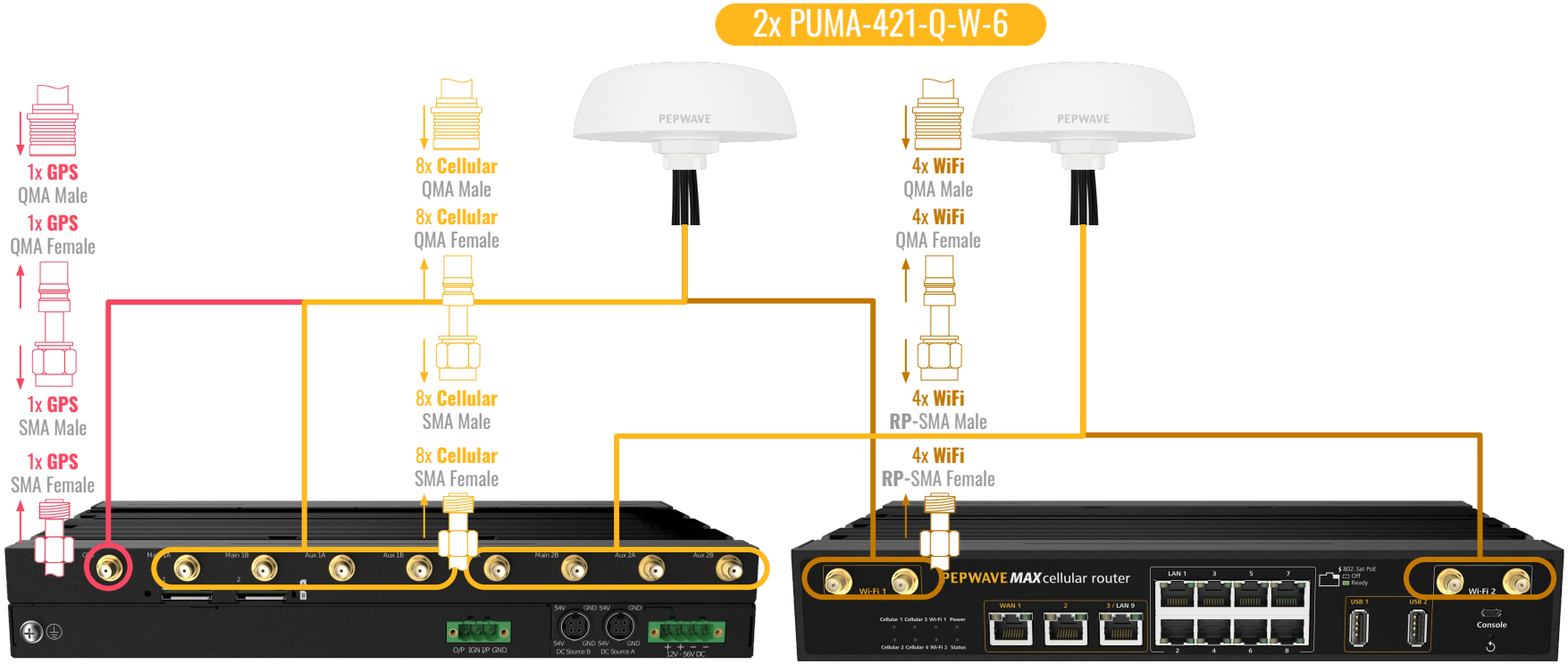
2m scenario

MBX connected directly to Puma antennas



4.5m scenario

MBX connected to Puma antennas with 4.5m extension cables

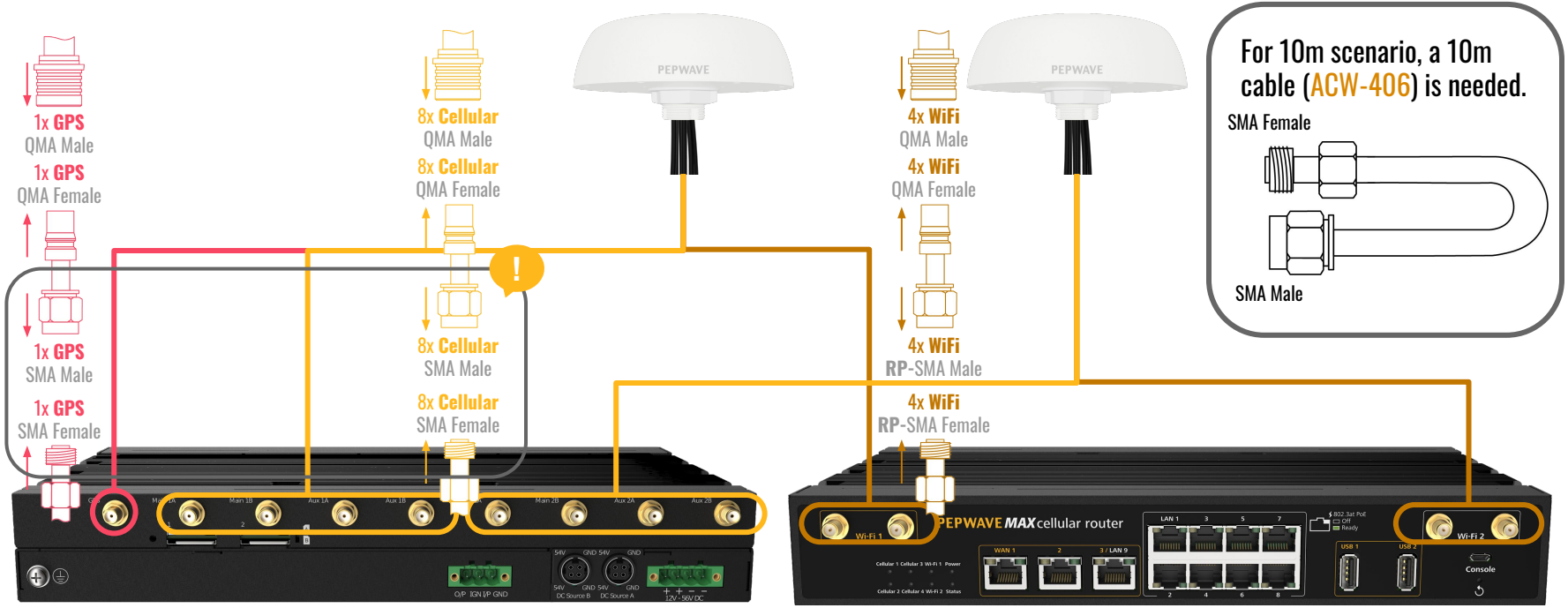


10m scenario

MBX connected to Puma antennas with 10m extension cables

peplink

2x PUMA-421-Q-W-6

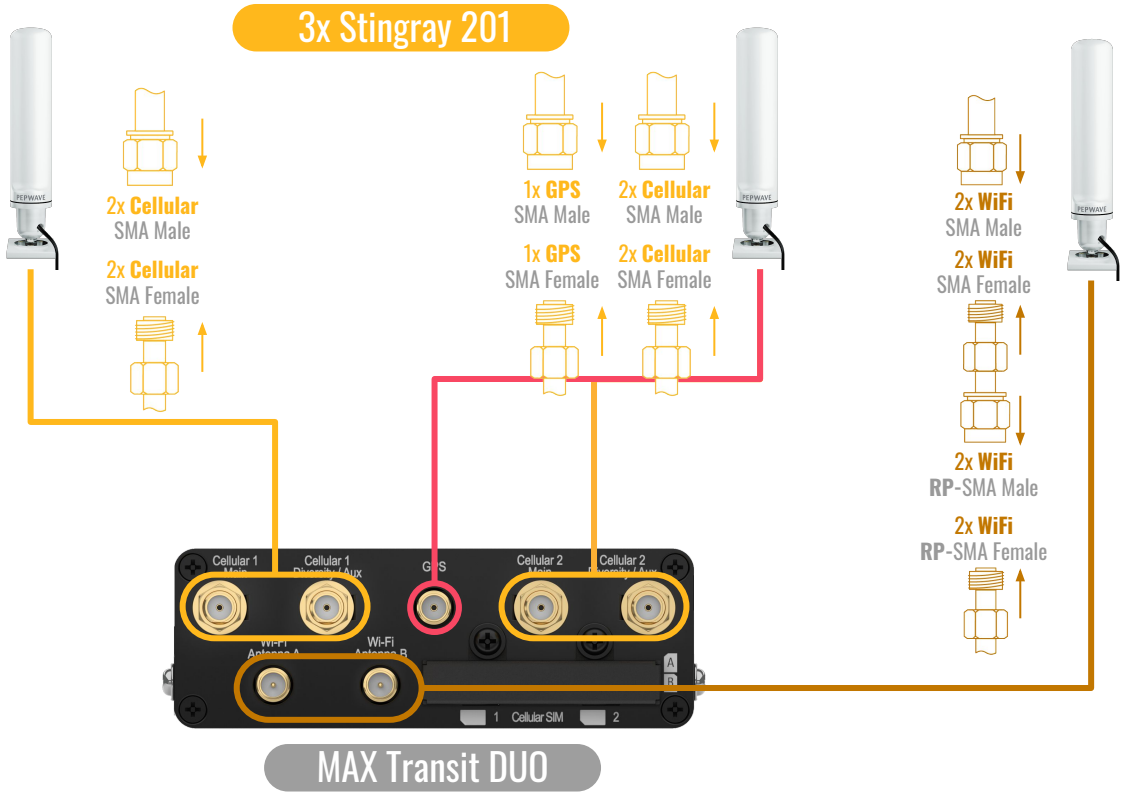


For 10m scenario, a 10m cable (ACW-406) is needed.

MBX HD2 CAT-18

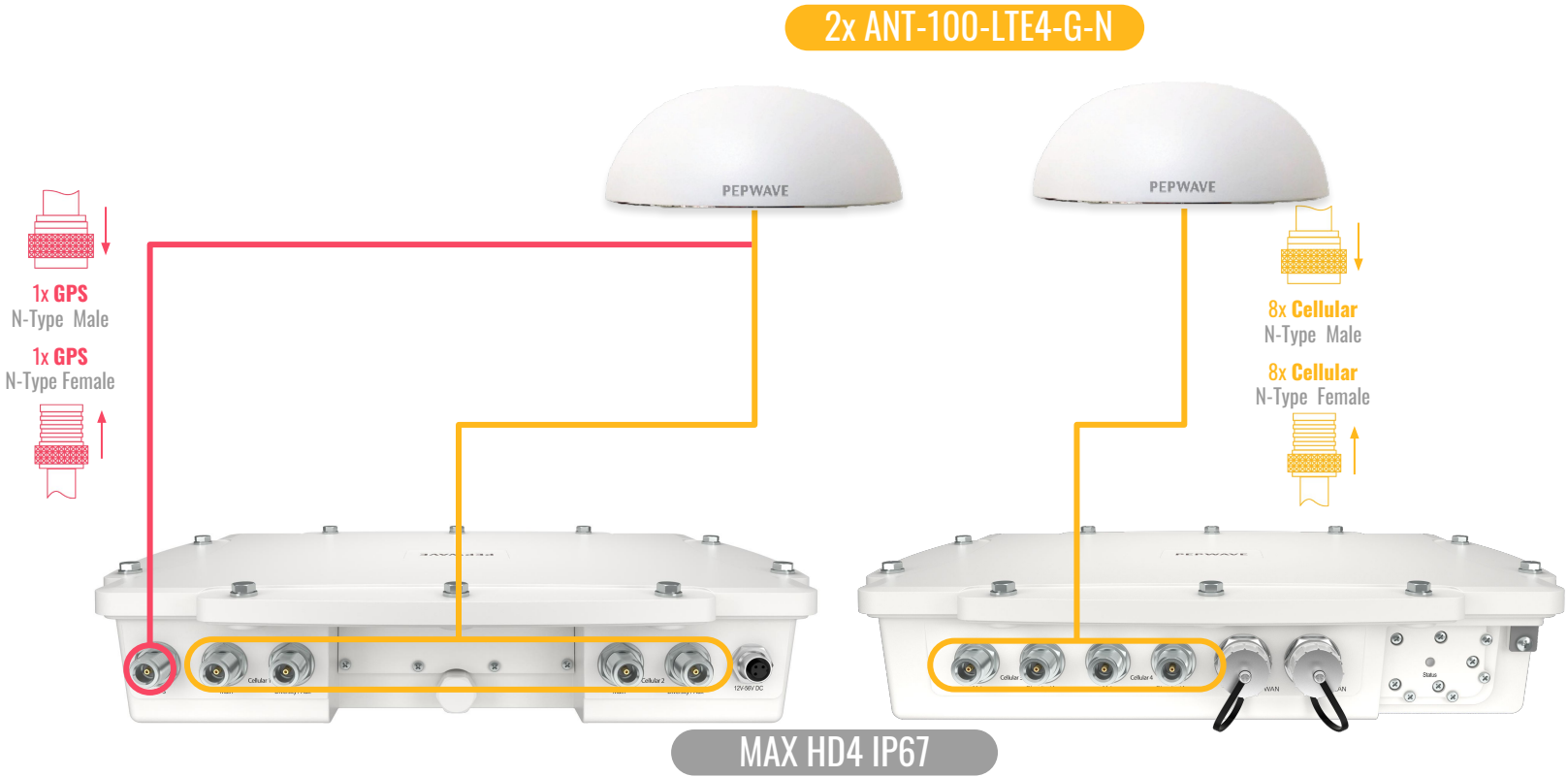
Examples Configuration

Transit DUO with Stingray antennas



Examples Configuration

IP67 HD4 with ANT-100-LTE4-G-N



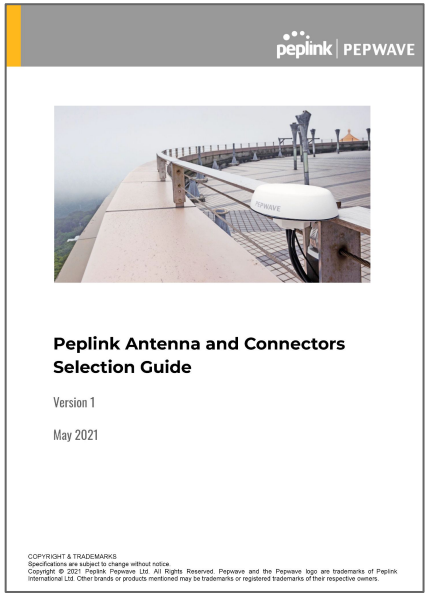
Causes of Low Signal

Cable & Antenna Installation Checklist

	Dos	Don'ts
Cables	• No splitters • Short cable runs • High-quality cables • Few connectors	• Passive splitters • Long cable runs • Low-quality cables • Lots of connectors
Antenna	• Good antenna placement (360° unobstructed) • Good antenna selection	• Bad antenna placement (blind spots) • Bad antenna selection

Resource Download

Peplink Antenna and Connectors Selection Guide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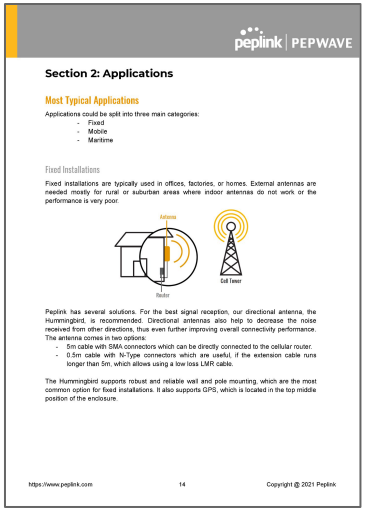
Peplink Antenna and Connectors Selection Guide

Version 1

May 2021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Section 2: Applications

Most Typical Applications

Applications could be split into three main categories:

- Fixed
- Mobile
- Maritime

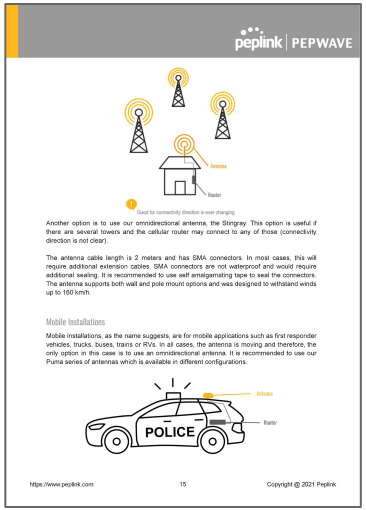
Fixed Installations

Fixed installations are typically used in offices, factories, or homes. External antennas are needed mostly for rural or suburban areas where indoor antennas do not work or the performance is very poor.

Peplink has several solutions. For the best signal reception, our directional antenna, the Hummingbird, is recommended. Directional antennas also help to decrease the noise received from other directions, thus even further improving overall connectivity performance. The antenna comes in two options:

- 5m cable with SMA connectors which can be directly connected to the cellular router.
- 0.5m cable with N-Type connectors which are useful, if the extension cable runs longer than 5m, which allows using a low loss LMR cable.

The Hummingbird supports robust and reliable wall and pole mounting, which are the most common option for fixed installations. It also supports GPS, which is located in the top middle position of the enclosure.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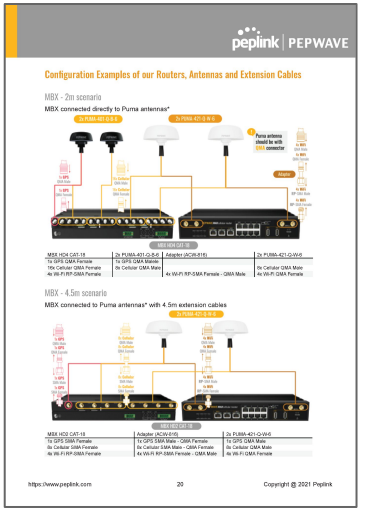
Another option is to use our omnidirectional antenna, the Stingray. This option is useful if there are several towers and the cellular router may connect to any of those (connectivity direction is not clear).

The antenna cable length is 2 meters and has SMA connectors. In most cases, this will require additional extension cables. SMA connectors are not waterproof and would require additional sealing. It is recommended to use self amalgamating tape to seal the connectors. The antenna supports both wall and pole mount options and was designed to withstand winds up to 160 km/h.

Mobile Installations

Mobile installations, as the name suggests, are for mobile applications such as first responder vehicles, trucks, buses, trains or RVs. In all cases, the antenna is moving and therefore, the only option in this case is to use an omnidirectional antenna. It is recommended to use our Puma series of antennas which is available in different configurations.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Configuration Examples of our Routers, Antennas and Extension Cables

MBX - 2m scenario

MBX connected directly to Puma antennas*

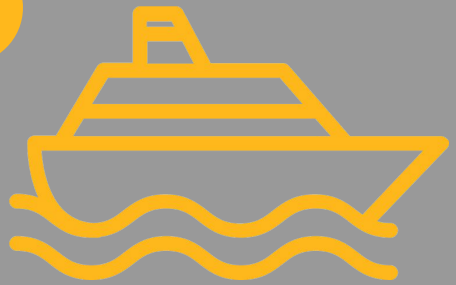
MBX - 4.5m scenario

MBX connected to Puma antennas* with 4.5m extension cables

Download now https://download.peplink.com/resources/peplink_antenna_and_connectors_selection_guide.pdf

Q & A

maritime@peplink.com



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